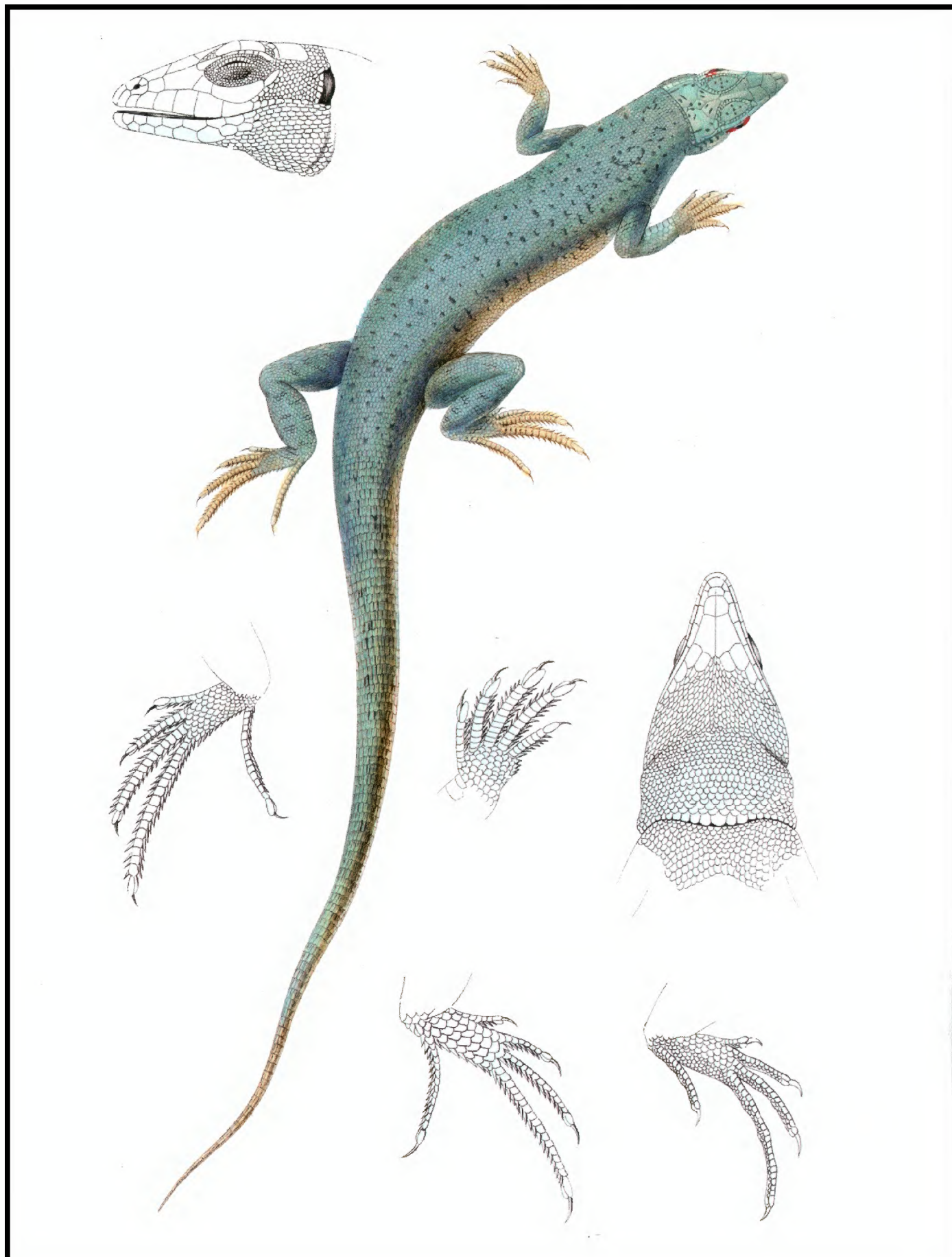

BULLETIN

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August 2024



BULLETIN OF THE CHICAGO HERPETOLOGICAL SOCIETY
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Book Review: *Snakes Without Borders* by Rick Shine
2024. 319 pp. Softbound. Reed New Holland Publishers. ISBN 9781921073700.

Reviewed by
David G. Barker
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Snakes Without Borders is a 6 × 8" softbound book, richly illustrated with beautiful color photographs of people, places, and snakes. The clarity and color of the photos are outstanding, and the print quality is excellent. At this time, the book is available from several Australian booksellers for about \$33 AUD (\$21.50 USD), but at the time of this review it's not yet available from a US bookseller.

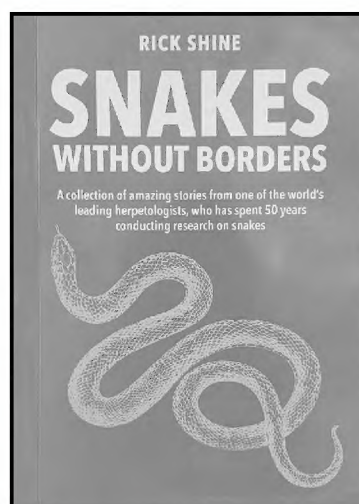
This book is an excellent example of storytelling. It is informative, educational, but never condescending. It's an excellent travelogue describing the details and the environments at the very different destinations that were experienced by Shine and his companions. Shine has an excellent sense of humor, much of it self-effacing, and many of these travel stories could be delivered as stand-up comedy.

The first sentence in Chapter 1 is "My name is Rick, and I'm a snake-a-holic." If you like snakes, this is a book written by a kindred spirit. Rick Shine is an Australian evolutionary biologist and ecologist, but, really, he is a herpetologist and an ophidiophile. For most of his career his interests and studies have been centered on snakes, but he has also done research with lizards and amphibians. Dr. Shine was on the faculty of University of Sydney, has authored and coauthored more than 1100 scientific papers, has described new species of herps, and has species named in his honor.

The first chapter is a brief overview of Shine's early career, at which time his research was mainly focused on the Australian herpetofauna. He was collecting specimens to bring back to the lab for study, and also studying museum specimens. In this endeavor, Shine dissected thousands of museum specimens and through this gained tremendous knowledge and insight on diets, sizes, and reproductive conditions of a wide variety of herps.

One day Shine was working in a museum with one of his mentors, John Legler, an authority on Australian turtles. At lunch, Legler made the following statement: "Any half-baked researcher can treat the wilderness like a supermarket, just going out and getting animals and bringing them home to do science with. But not everyone can gather data on animals in the field. That's the mark of a true field biologist."

Of course, field biology, especially in foreign countries, is not simple and not easy. But Legler's challenge struck a chord with Shine. He began to plan to leave most of his Australian projects and travel the world with a goal to visit the "snakiest" places on the planet. In order to escape the general problems of snake research—low capture rates and very secretive animals—Shine decided to move his research to places where snakes were abundant and where snakes could be observed easily. The book that follows is the recounting of expeditions to and research accomplished at far-off destinations where those two requirements were satisfied, places where snakes could be found in



amazing numbers. Of course, due to his responsibilities as professor and lecturer, he was able to travel only a month or two of each year.

The second chapter of the book is about the first international destination to which Shine turned his attention. It was a place that easily satisfied one of the two conditions that he sought—snakes were very plentiful. Shine and a crew of graduate students and fellow researchers went to Indonesia—to the python slaughterhouses and skinning businesses in Sumatra. Here Shine had access to thousands of freshly collected and freshly killed reticulated pythons, blood pythons and water monitors. This was a replay of his research in Australian museums, but it was possible to obtain a tremendous amount of data regarding the previously unknown sizes, diets and reproductive cycles of these animals.

Interestingly, very little had been published about even the most basic data for giant reptiles prior to Shine's work, which began in the 1990s. Giant reptiles generally draw a lot of attention from people, whether visitors to zoos, snake keepers, or herpetologists in general. However, museums around the world have a strong bias against maintaining preserved giant reptiles. Giant reptiles are expensive for museums; the containers to hold their bodies are expensive, the amount of preservatives necessary to embalm a giant reptile is exorbitant, and the space to keep them is limited. Around the world there are embarrassingly few giant reptile specimens held in museums. I visited the Indonesian National Museum in Bogor in 1992 and found one preserved small reticulated python in the collection—this in a nation of 20,000 islands that almost all host reticulated pythons. This dearth of specimens of giant reptiles in museums has severely limited the abilities of herpetologists to gain even basic understandings of the morphology, regional variations, diets, and reproductive cycles of the giants. Dr Shine's research in Sumatra was landmark stuff.

The research of Shine and company also provided the first hard data regarding the sustainability of the python skin trade. The trade in skins of wild pythons, considered rare commodities, is massive. At the time, Indonesia reported the harvest of half a million reticulated python skins and a quarter million skins from blood pythons. The annual take of large monitor lizards was even greater—two millions skins a year were exported. Research showed that the annual take of these animals was not diminishing, and the average size of the harvested animals was not decreasing. This was the very first real evidence that the giant reptile skin trade was not negatively affecting the wild populations.

Okay, maybe my personal interest in pythons has made me dwell on this python chapter a bit more than necessary for a review. This book is a travelogue about snakes. Shine writes about his own experiences and insights, and he relates the sto-

ries of the people he met in his travels. He carefully summarizes the results of his research in the skinning slaughterhouses in very readable fashion—no unnecessary jargon here, but there are some memorable interactions with giant snakes.

From Sumatra, Shine moves to Sweden in Chapter 3. He traveled to the small town of Smygehuk to study a small population of Eurasian adders (*Vipera berus*) that are restricted to a small area of parkland. There he joined with Thomas Madsen, a Ph.D. student studying courtship, combat, and mate selection in the adders. A few years later Madsen and Shine studied the dense water python (*Liasis fuscus*) population at Fogg Dam in the Northern Territory.

From there, on to China in Chapter 4. Shedao Island is a small rocky island that is home to the Shedao pitviper, (*Gloydius shedaoensis*). Shedao Island covers 73 rocky hectares located 10 km off the coast of far northeastern China. It hosts the densest population of pitvipers in the world. Shedao has more venomous snakes per square meter than any other place in the world, and the snakes are everywhere—on the ground, in the bushes, and especially in the trees. And this is no wimpy little viper; they are big-headed, relatively heavy-bodied and adults are longer than a meter.

Shedao Island is little known here in the West. It is heavily protected by the Chinese government. Much research has been done by Chinese scientists on this unique population of vipers, but little was translated and published outside of China. In 1999, Shine and his companion for the trip, Xavier Bonnet, were the first western scientists ever to visit the island. A second trip was made in May 2000. It was mutually beneficial; Shine and companions learned how the Chinese scientists had done their research and they shared their western methods of research with those researchers.

In chapters 5 and 6, Shine deals with his travels to Manitoba to experience the spring emergence of the hundreds of thousands of red-sided gartersnakes (*Thamnophis sirtalis parietalis*). It is a place that well satisfied many of the requirements necessary to make this a long-term project: a massive number of easily-observed snakes; a safe and accessible study site in an English speaking country; local researchers with whom to collaborate. Shine's main complaint seemed to be that there was no nearby coffee shop. Despite that, he returned there each spring for eight years. The adventures, the stories, and the recounting of the research that was accomplished make this a memorable chapter.

In Chapter 7 the adventures get tropical. Shine turns his attention next to sea kraits and begins his travels to Fiji. Sea kraits (subfamily Laticaudinae) are not sea snakes (subfamily Hydrophiinae). Sea kraits are semiaquatic venomous snakes that spend about an equal amount of time in tropical seas (feeding) as they do on land (digesting and laying eggs). They have wide ventral scales, like terrestrial snakes, and a paddle-like tail like the sea snakes. They seem fearless and mostly ignore humans, making them ideal to observe, and, best of all, they are very hesitant to bite, even when being handled. Shine describes them as “docile beyond belief.” In some areas they are plentiful. Sea kraits are believed to be closely related to Asian elapids, while the sea snakes are descended from the Australian elapids.

Here Shine and fellow researchers set up camp on a sandy beach on a small island, Mabualau, and begin their study of the yellow-lipped sea krait (*Laticauda colubrina*). Their nearest neighbor is a large colony of noisy and odoriferous seabirds. Once a week a supply boat visited the island, sometimes bringing requested items. But it is a beautiful place and there are lots of sea kraits.

After several years at this locality, the study is moved about 600 miles to the west, closer to Australia, to the island chain of Vanuatu. Three species of sea kraits are present there, and research is directed to understanding the isolating mechanisms that keep the sea kraits from hybridizing.

Chapter 8 begins in 1997, when Shine went New Caledonia and there was introduced to the turtle-headed sea snake (*Emydocephalus annulatus*). This species feeds solely on fish eggs, and is unique among sea snakes in that it does not have functional fangs or potent venom—in essence, a harmless sea snake. Camp is a comfortable hotel room and coffee is always nearby. This began a study that lasted 20 years.

Chapter 9 also takes place in New Caledonia. Several sea snake species co-exist with the turtleheads there. Some are big, highly venomous sea snakes such as the olive sea snake (*Aipysurus laevis*) and the greater sea snake (*Hydrophis major*). At first the researchers are hesitant to work with those snakes, primarily because they spend much time out in the ocean in deeper water. But at an Australian bio-herp meeting in 2016 Shine met Vinay Udyawer, a Ph.D. student who had modified a locator system used to study sharks so that it could be used to monitor the travels of the larger sea snakes. They began a research project together in New Caledonia. Shine reports that these larger sea snake species are generally very inoffensive and hesitant to bite when encountered underwater, even when being carefully captured, but they will actively try to bite if taken from the water.

It's my observation that few zoological researchers can claim to have chosen their study subjects because they have been fascinated by the organism since childhood. Shine writes that he was “besotted” by snakes since his first memories, and frustrated because most of his life snakes that he encountered only wanted to get as far away from him as possible. The gartersnakes of Manitoba, and their complete fearlessness of the humans observing them, deeply affected him. One of my favorite sentences in the book is Shine writing that while among the gartersnakes he tried to maintain his “professional persona,” but his inner five-year-old “was squealing with glee.”

Chapter 10, a short afterword for the book, has many reasoned and wise things to say about the world from a man who has studied snakes his entire life and who has traveled the world for three decades following snakes. Shine gives a brief summation of what was experienced and learned in his trips. Throughout the book he has illustrated his deep affection for snakes, and here he describes their importance. He shares his very realistic thoughts on the world today and the future that snakes face. The last sentence in the book is “We are fortunate to share this planet with such elegant, mysterious, entrancing fellow travellers—the snakes.”

Taxonomic and Geospatial Review of the Herpetofauna of Sinaloa, Mexico

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Posgrado en Ciencias Aplicadas al Aprovechamiento de los Recursos Naturales

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Abstract

Databases and species catalogs are vital for biodiversity conservation, although errors and incomplete data can affect the accuracy of studies and decision-making. This study reviews the herpetofauna of Sinaloa, identifying misassigned species and documenting absences in previous lists. Sinaloa, with its diverse topography and climate, hosts 37 species of amphibians and 128 species of reptiles, according to an exhaustive review of databases and scientific literature. This significant update compared to previous studies underscores the importance of accurate information for effective conservation policies. It is recommended to review historical and contemporary records, ensure correct identifications, avoid errors in new records, and optimize management plans for threatened species, thereby contributing to the knowledge and conservation of Sinaloa's biodiversity.

Keywords: amphibians; reptiles; biodiversity; data validation; species accuracy

Resumen

Las bases de datos y catálogos de especies son vitales para la conservación de la biodiversidad, aunque errores y datos incompletos pueden afectar la precisión de los estudios y la toma de decisiones. Este estudio revisa la herpetofauna de Sinaloa, identificando especies mal asignadas y documentando ausencias en listados previos. Sinaloa, con una topografía y clima diversos, alberga 37 especies de anfibios y 128 de reptiles, según una revisión exhaustiva de bases de datos y literatura científica. Esta actualización significativa respecto a estudios anteriores destaca la importancia de información precisa para políticas de conservación efectivas. Se recomienda revisar registros históricos y contemporáneos, asegurar identificaciones correctas, evitar errores en nuevos registros y optimizar los planes de manejo para especies amenazadas, contribuyendo así al conocimiento y conservación de la biodiversidad en Sinaloa.

Palabras clave: anfibios; biodiversidad; exactitud de las especies; reptiles; validación de datos

Introduction

Databases, lists, and species catalogs are fundamental tools for biodiversity research and conservation, providing a detailed and systematic record of biological richness across various regions (Possingham et al., 2002; Graham et al., 2019). These sources of information are crucial for the accurate identification and classification of species, enabling researchers to monitor changes in biodiversity, assess species conservation status, and design effective management strategies (Keith et al., 2014). However, errors in taxonomic assignment and data gaps can significantly compromise the accuracy of scientific studies and conservation decision-making (Rodrigues et al., 2006). Misidentification of species can lead to the implementation of inadequate measures, wasting resources and potentially harming species in need of urgent protection (Mace, 2004). Moreover, data deficiencies can create knowledge gaps, hindering a comprehensive and precise assessment of biodiversity and the threats it faces, which is essential for the development of evidence-based conservation policies.

The first study on the composition of amphibians and reptiles

in Sinaloa was conducted by Taylor (1936). Three decades later, Hardy and McDiarmid (1969) made a significant contribution to the herpetofauna of northwest Mexico, particularly in Sinaloa. However, after this period, field exploration in the state declined, and contributions were limited to species lists. As a result, herpetological studies comparing the herpetofauna of Sinaloa included records without evidence (e.g., Enderson et al., 2009). Furthermore, due to the increasing trend of updating amphibian and reptile lists in Mexico, a comprehensive review was not conducted in several regions of the country, including Sinaloa (Lemos-Espinal and Smith, 2020). Although attempts have been made to correct these errors and omissions (see Reyes-Velasco et al., 2020), they continue to occur without clear justification for the modifications made (Lemos-Espinal and Smith, 2023).

On the other hand, Ramírez-Bautista et al. (2023) provided an updated species list of the herpetofauna of Mexico based on a historical and contemporary review, mentioning a herpetofaunal composition of 190 species (46 amphibians and 144 reptiles) for Sinaloa. This figure is significantly higher compared to the species reported by Lemos-Espinal and Smith (2020), who listed

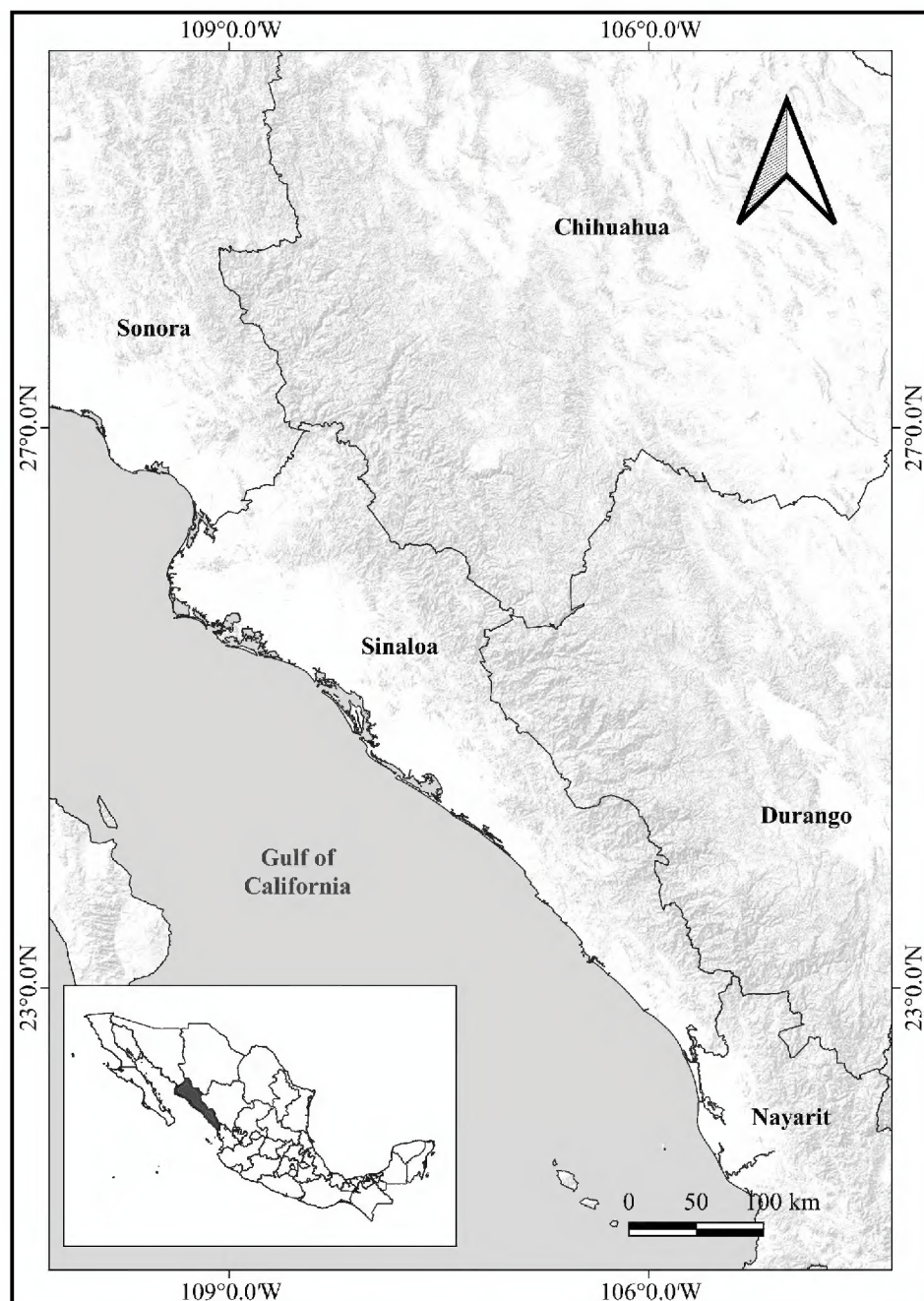


Figure 1. Geographic location of the state of Sinaloa, Mexico.

a total of 159 species (39 amphibians and 120 reptiles). It is important to note that Ramírez-Bautista et al. (2023) did not provide a detailed species list or specify the extent of their data review. Additionally, they omitted recent contributions to the herpetofauna of Sinaloa (Castro-Bastidas and Serrano, 2022; Castro-Bastidas, 2022; Gamez-Duarte et al., 2023; Grünwald et al., 2023a,b; Payan-Cazares et al., 2023; Grünwald et al., 2024a,b) in their studies and in the new state comparison of Nayarit (Loc-Barragán et al., 2024).

The decision to conduct this specific review for the state of Sinaloa arises from the urgent need to correct and update existing taxonomic and geospatial information. Sinaloa, with its rich biological diversity, has been the subject of herpetological studies that, unfortunately, have included records lacking adequate evidence and significant omissions in recent literature. In this study, I identify misassigned species, document species missing from lists or databases, and, most importantly, provide strong arguments for their inclusion, verification, or exclusion based on compiled evidence.

This lack of precision not only compromises the quality of scientific studies, but can also lead to the implementation of ineffective conservation policies. By providing a solid foundation of reliable data, this review aims to fill existing knowledge gaps, enabling researchers and decision-makers to have accurate and updated information. In doing so, it will strengthen the capacity to monitor and protect the herpetological biodiversity of Sinaloa, as well as future studies on systematics and taxonomy.

Study site

The state of Sinaloa, located in the northwest of Mexico, is bordered by Sonora to the north, Chihuahua and Durango to the east, Nayarit to the south, and the Gulf of California to the west (Figure 1). Its topography is characterized longitudinally by the Sierra Madre Occidental in the east, an extensive central plain, and the Pacific coast to the west, where at least ten rivers drain (Hardy and McDiarmid, 1969). The region reaches a maximum elevation of up to 2,800 meters, and the coast is marked by large mangrove lagoons and islands. The elevated areas in the east are covered by oak and pine-oak forests, while tropical dry forest predominates on the western slopes. However, natural vegetation has largely been replaced by agriculture and livestock (Lemos-Espinal and Smith, 2020). The climate ranges from warm sub-humid in the south and western slopes to semi-arid and arid along the coast and northwest, with concentrated summer rainfall (INEGI, 2017).

Materials and methods

Following a request from an editor of The Reptile Database to analyze reptile records in Sinaloa, I expanded the analysis to include amphibians as well. For this assessment of species records, I reviewed primarily official sources such as databases and scientific literature. Databases consulted included the Global Biodiversity Information Facility (GBIF) and VertNet. Additionally, I reviewed the amphibian database, i.e., Amphibian Species of the World (Frost, 2024), and the reptile database, i.e., The Reptile Database (Uetz et al., 2024). Furthermore, this assessment included a review of the literature on the herpetofauna of Sinaloa, encompassing works by Hardy and McDiarmid (1969), Lemos-Espinal and Smith (2020), and Castro-Bastidas and Serrano (2022), among others. Finally, specialists were consulted to provide feedback on taxonomic changes and species verification.

Results

Frost (2024) lists 39 amphibian species, and Uetz et al. (2024) list 132 reptile species, totaling 171 herpetozoan species for Sinaloa. Following a review of literature and historical records, a total of 46 amphibian species and 135 reptile species were identified. Upon examining and analyzing these records, 37 amphibian species and 128 reptile species are confirmed to be present in Sinaloa. Table 1 presents amphibian and reptile species that require exclusion, verification, or inclusion in the herpetofaunal composition of Sinaloa, based on recent taxonomic changes and omissions. For amphibians, eight species are slated for exclusion, four species require verification, one species should be added, and one is a nomenclature change. For reptiles, seven species are marked for exclusion, three species require verification, three species should be included, and there is one nomenclature change.

Discussion and conclusion

The present study provides a comprehensive and detailed revision of the herpetofauna of Sinaloa, addressing inconsistencies and errors in taxonomic assignment and data gaps in previous studies. Through consultation of official databases, scien-

Table 1. A critical review of the taxonomy of the herpetofauna of Sinaloa, Mexico.

Amphibian species	Reptile species
Species to be excluded	
<i>Anaxyrus mexicanus</i>	<i>Anolis conspersus</i>
<i>Craugastor pygmaeus</i>	<i>Anolis utowanae</i>
<i>Eleutherodactylus modestus</i>	<i>Sceloporus lemosespinali</i>
<i>Eleutherodactylus nitidus</i>	<i>Lampropeltis greeri</i>
<i>Eleutherodactylus teretistes</i>	<i>Oxybelis aeneus</i>
<i>Lithobates cora</i>	<i>Oxybelis vittatus</i>
<i>Isthmura sierraoccidentalis</i>	<i>Kinosternon hirtipes</i>
<i>Ambystoma nigrum</i>	
Species requiring verification	
<i>Incilius occidentalis</i>	<i>Masticophis mentovarius</i>
<i>Craugastor hobartsmithi</i>	<i>Rhinocheilus antonii</i>
<i>Sarcohyla hapsa</i>	<i>Sonora mutabilis</i>
<i>Lithobates forreri</i>	
Species to be included	
<i>Eleutherodactylus jamesdixoni</i>	<i>Crocodylus moreletii</i>
	<i>Crotalus willardi</i>
	<i>Rhadinaea taeniata*</i>
Nomenclature changes	
<i>Aquarana catesbeiana</i>	<i>Sonora cincta</i>

* Recent state record in Grünwald et al. (2024b).

tific literature, and input from specialists, a reassessment of amphibian and reptile species records in Sinaloa was achieved. This analysis revealed that the herpetofauna of Sinaloa consists of 37 amphibian species and 128 reptile species, following the exclusion of erroneous records and inclusion of newly verified species. These figures represent a significant update compared to earlier studies and reflect taxonomic changes and identified omissions. This work is expected to establish a solid foundation for future studies in systematics and taxonomy, contributing to the understanding and conservation of the region’s rich biodiversity.

Among the databases for amphibians and reptiles (Frost, 2024; Uetz et al., 2024), as well as a review of the recent literature, there is a 10% discrepancy from the data reported by Ramírez-Bautista et al. (2023) for Sinaloa. It is likely that those authors did not account for synonymies and included erroneous records. Furthermore, when comparing these data with recent lists of amphibians and reptiles in the state (Lemos-Espinal and Smith, 2020; Castro-Bastidas and Serrano, 2022), an increase of seven reptile species and a reduction of six amphibian species were identified. This is noteworthy as herpetological studies in Sinaloa are growing, alongside taxonomic changes (Castro-Bastidas, 2024). Below are comments on the taxonomic review of species:

***Anaxyrus mexicanus*.** Enderson et al. (2009) included this species as part of the herpetofauna of Sinaloa, without evidence of collected specimens or photographs of individuals.

***Incilius cf. occidentalis*.** Van Devender et al. (2022) and Castro-Bastidas et al. (2024) noted that individuals of *Bufo occidentalis* (*sensu lato*) in northwest Mexico do not exhibit fully diagnostic

characteristics of *I. mccoysi* as proposed by Santos-Barrera and Flores-Villela (2011). It is likely that these individuals, lacking diagnostic features of *I. mccoysi* in this region, belong to an unidentified species complex (personal communication, Darrel Frost).

***Craugastor cf. hobartsmithi*.** Recently, Castro-Bastidas (2024) commented that individuals assigned as *C. pygmaeus* and *C. hobartsmithi* from Sinaloa likely represent an undescribed species and that further studies are needed.

***Eleutherodactylus nitidus*.** Grünwald et al. (2021) redefined the range of *E. nitidus* to central-southern Mexico, leaving undescribed the individuals of this species in the northwest region of the country. Recently, Devitt et al. (2023) described *E. jamesdixoni* after examining historical collections that had previously been assigned as *E. nitidus*, shedding light on the specimens not described by Grünwald et al. (2021).

***Eleutherodactylus pallidus*.** Loc-Barragán et al. (2020) provided the first record of this species for Sinaloa and indicated that individuals previously identified as *E. modestus* and *E. teretistes* in Sinaloa had been misidentified. They actually belong to representatives of this species.

***Lithobates cf. forreri*.** Recently, Castro-Bastidas (2024) commented that a reexamination and additional collection of *L. forreri* are needed to support the proposal by Pérez-Ramos and Luja-Molina (2023) regarding its identification as *L. cora*. Furthermore, nuclear DNA molecular data are required to clarify the phylogeny of the group (personal communication, Darrel Frost).

***Lithobates megapoda*.** A single specimen was collected in Mazatlán (MCZ 8629). Dunn (1922) initially identified this specimen as *L. pustulosus*, but Oliver (1937), upon reexamination, reassigned it as *L. montezumae*. Later, Hardy and McDiarmid (1969) questioned this identification after a more detailed analysis, suggesting that certain characteristics might indicate the specimen belongs to *L. megapoda*. However, due to its preservation condition, they preferred to follow the Oliver (1937) classification. The authors also noted that, regardless of the specific identity between these two species, both *L. montezumae* and *L. megapoda* are limited to the Mexican highlands, whereas Mazatlán represents a habitat different from the one typically associated with these species. Therefore, they decided not to include *L. montezumae* in the state herpetofauna. In 2021, this specimen was reexamined and determined to correspond to *L. megapoda* (verified by Gustavo Campillo García), supporting Hardy and McDiarmid (1969) perspective that there might have been an error in the geographical assignment.

***Ambystoma rosaceum*.** Several authors have suggested that this species may represent a species complex. Shannon (1951) proposed up to three subspecies based primarily on differences in larval coloration across various populations (*A. r. sonoriensis*, *A. r. rosaceum*, and *A. r. nigrum*), but Anderson (1961) found these subspecies not valid. Subsequently, Shaffer (1983) recognized two subspecies (*A. r. rosaceum* in the northern part of the distribution area and *A. r. nigrum* in the south) based on allozyme differences. However, Tanner (1989) only recognized two subspecies based on morphological characteristics. Later,

Highton (2000) suggested that data from Shaffer and McKnight (1996) indicated *A. rosaceum* might actually represent three species, supporting Tanner's arguments (1989). Recently, Raffaëlli (2022) elevated the subspecies *A. r. nigrum* to species level, although these yet unrecognized taxa await molecular confirmation. Due to the lack of phylogenetic studies and additional specimen collections along the slope of the Sierra Madre Occidental, a conservative approach is recommended, assigning these individuals to *A. rosaceum* until a comprehensive study is conducted.

***Isthmura sierraoccidentalis*.** Enderson et al. (2009) included this species as part of the herpetofauna of Sinaloa, without evidence of collected specimens or photographs of individuals.

***Crocodylus moreletii*.** The COCOMEX crocodile farm, based in Culiacán, was founded in 1989 and permanently ceased operations in early 2016. During its operation, there was speculation about crocodile escapes possibly caused by increased water flow in the Culiacán River. However, one study suggested the possibility of hybrid individuals after morphological examination with a population of *C. acutus* in Sinaloa (Salomón-Soto, 2013). It is recommended that this species be added to the Sinaloa listing upon molecular confirmation of this finding.

***Barisia ciliaris*.** Hardy and McDiarmid (1969: pp. 218-219) referred to this species as *Gerrhonotus imbricatus ciliaris*. They chose not to include this species in their list of the herpetofauna of Sinaloa due to potential misassignment of geographical coordinates in the coastal plain of Escuinapa. However, a specimen of this species (CMNAR 8296: as *B. imbricata*), not examined by the authors, was collected in the Sierra Concordia. Therefore, this species was included in the list provided by Lemos-Espinal and Smith (2020).

***Anolis nebuloides*.** Hardy and McDiarmid (1969) reviewed the specimens of *Anolis* from Sinaloa and concluded that reports of *A. nebuloides* are erroneous, and were based on misidentified specimens of *A. nebulosus*.

***Anolis utowanae*.** Barbour described the species in 1932 during his expedition from the Caribbean to the coasts of Sinaloa aboard his yacht named *Utowana* (Cochran, 1934). However, among all the collections made, there exists only one specimen assigned to Mexico, in Sinaloa. Hardy and McDiarmid (1969) conducted field explorations in search of individuals of this species at the supposed type locality, Mazatlán, but found nothing. Those authors examined the holotype of *A. utowanae* and noted significant differences from *Anolis* species in the region. More recently, Poe (2014) reviewed the Barbour family's diaries from their Utowana yacht expedition. Poe concluded that *A. utowanae* shares morphological characteristics with *A. conspersus* from the Caribbean region. Because of this, Poe (2014) considered *A. utowanae* a junior synonym of *A. conspersus*, although he mentioned that Barbour's account of obtaining *Anolis* specimens in Sinaloa appears credible, as corroborated by his wife Mary's account. Poe (2014) also suggested that the specimen collected in Mazatlán may have been mistakenly associated with the Caribbean *Anolis* series. *Anolis utowanae* has recently been included in the herpetofaunal lists of Sinaloa (Enderson et al., 2009; Lemos-Espinal and Smith, 2020) despite these discrepan-

cies and its consideration as a synonym of *A. conspersus* (Nicholson et al., 2018). Prior to the historical and taxonomic review of this species, Stuart (1955) had already suggested that this species should be regarded as a questionable record. On the other hand, Aguirre-Zazueta et al. (2023a) suggested that this species requires verification due to the lack of records for over 50 years. Poe (2014) explicitly comments, "It remains a mystery how the specimen became associated with Mazatlán."

***Ctenosaura pectinata*.** Smith and Taylor (1950) grouped *C. brachylopha*, *C. brevirostris*, and *C. parkeri* with *C. pectinata*, and restricted the name *C. acanthura* to iguanas from the Gulf of Mexico area. Zarza et al. (2019) suggested resurrecting *C. brachylopha* for populations north of *C. pectinata*, although their study appears to have examined only four specimens (or specimens from four localities), one of which (from a more southern locality) appeared to be a hybrid of *C. brachylopha* and *C. pectinata*. Verification of more specimens of *C. pectinata* in the northwest region of Mexico, along with genetic data, is needed to support the lineages proposed by Zarza et al. (2019).

***Sceloporus lemosespinali*.** The Reptile Database (Uetz, 2024) includes this species in Sinaloa, although Lemos-Espinal and Smith (2020) merely indicated that its presence in the state is probable. It is recommended to exclude this species from the herpetofauna of Sinaloa, as there is no evidence supporting its occurrence.

***Plestiodon colimensis*.** There is only one record of this species in Sinaloa (Webb, 1959). Despite the considerable geographic distance between Sinaloa and the type locality in Colima, it is suggested to verify the presence of this species due to the lack of records for over 50 years (Aguirre-Zazueta et al., 2023a).

***Boa sigma*.** Previously considered as *B. constrictor* (a species restricted to South America), Card et al. (2016) found genetic evidence suggesting that *B. sigma* may be a valid species along the Pacific coast slope of Mexico. However, the authors did not provide morphological details or other diagnostic criteria for this taxon. There appears to be substantial overlap in the ranges of *B. imperator* (southern Mexico and Central America) and *B. sigma*, especially in Oaxaca (Card et al., 2016). However, it is still unclear if hybridization occurs in the overlap area.

***Lampropeltis greeri*.** Enderson et al. (2009) included this species as part of the herpetofauna of Sinaloa; however, there is no evidence of its presence in the state. Castro-Bastidas (2024) suggested excluding this species from the herpetofaunal lists of Sinaloa due to the lack of collected specimens and photographs of individuals.

***Masticophis lineatus*.** O'Connell and Smith (2018) elevated *M. lineatus* to full species status. The authors assigned the holotype of *M. mentovarius* collected in Mazatlán to *M. lineatus*, suggesting that a review of other specimens of *M. mentovarius* is needed to clarify the actual distribution of the species in Sinaloa.

***Oxybelis microphthalmus*.** Jadin et al. (2020) revalidated the species previously synonymized with *O. aeneus* (which they restricted to South America).

***Oxybelis vittatus*.** This species was previously considered synonymous with *O. aeneus*, but Jadin et al. (2020) reinstated it.

However, this change appears premature because the authors only had one sample of *O. aeneus* with a known location in their phylogenetic analysis. According to The Reptile Database (Uetz et al., 2024), this species is listed as part of the herpetofauna of Sinaloa. It is suggested to maintain a conservative stance due to the lack of thorough research validating this taxonomic change. Therefore, it is recommended not to include this species in the species lists of Sinaloa.

***Rhinocheilus antonii*.** The snakes of this genus exhibit significant variability, which has led to the description of several subspecies that are sometimes elevated to the rank of full species. The taxonomic status of *R. antonii* has been the subject of extensive debate. Manier (2004) determined that none of the subspecies showed consistent divergence in all analyses, justifying their recognition as separate subspecies. Lemos-Espinal and Smith (2020) did not include *R. antonii* in their list for Sinaloa, possibly considering it a subspecies of *R. lecontei*. It is recommended to adopt a conservative stance due to the limited number of available specimens; it would be prudent to postpone the decision on its taxonomic status (i.e., the possibility of elevating it to species level) until more specimens can be examined and additional data on molecular variation are analyzed.

***Sonora cincta*.** *Chilomeniscus cinctus* and *C. punctatissimus* were synonymized with *C. stramineus* by Grismer et al. (2002). However, Cox et al. (2018) revalidated these taxa under the names *Sonora straminea*, *S. cincta*, *S. punctatissima* and *S. fasciata*.

***Sonora mutabilis*.** This species needs verification because only one specimen has been found in Sinaloa after more than 50 years (Aguirre-Zazueta et al., 2023a), although the collected specimen does not have a recorded collection date (UTA-R 7227).

***Leptodeira septentrionalis*.** The Reptile Database (Uetz et al., 2024) does not include this species in the herpetofauna of Sinaloa. However, Costa et al. (2022) argue that *L. polysticta* and *L. septentrionalis* are not sufficiently differentiated to justify recognizing *L. polysticta* as a separate species, considering it rather a subspecies of *L. septentrionalis*. Aguirre-Zazueta et al. (2023b) support this perspective, and subsequently, Castro-Bastidas (2024) notes that Barrio-Amoros (2019) only compiled literature and photographs without examining specimens from Mexico. Given the direct analysis conducted by Costa et al. (2022), it is recommended to maintain this conservative stance regarding the taxonomic status of this species until more specimens can be examined.

***Thamnophis eques*.** Lemos-Espinal and Smith (2020) omitted this species from their list of the herpetofauna of Sinaloa, despite historical records of the species in the state (see Castro-Bastidas, 2024). Subsequently, Grünwald et al. (2024b) reported this species for the first time in Sinaloa, without considering the historical records. It is possible that the individual reported by Grünwald et al. (2024b) is *T. cyrtopsis* or another subspecies of *T. eques* (HACB, personal observations and data verified by Javier Manjarrez). It is recommended that the authors provide a detailed description of the morphological characteristics used for species identification or share photographs from different body perspectives of the individuals.

***Thamnophis melanogaster*.** Two specimens (AMNH 19527-28) of this snake were supposedly collected by Paul R. Ruthling in Mazatlán. Hardy and McDiarmid (1969) examined these specimens and decided to exclude them from the herpetofauna of Sinaloa due to the likely incorrect assignment of geographical coordinates, as it is a common species in the Mexican Altiplano. Castro-Bastidas (2024) traced Paul R. Ruthling's exploration route in Sinaloa and it appears he did not visit the mountainous region of the state. On the other hand, Lemos-Espinal and Smith (2020) suggested the possible presence of this species in the Sierra de Sinaloa. It is recommended not to include this species in the herpetofaunal lists of Sinaloa until evidence confirming its occurrence is obtained.

***Crotalus willardi*.** The Reptile Database does not mention this species as part of the herpetofauna of Sinaloa (Uetz et al., 2024). Grünwald et al. (2023a) were the first to record this species in the state.

***Kinosternon hirtipes*.** There are few collected specimens of this species in Sinaloa (CNAR 765). Hardy and McDiarmid (1969) reviewed the specimen collected in Mazatlán and noted that this locality does not match historically recorded habitats for this species. Lemos-Espinal and Smith (2020) included this species in their list without specific justification. It is possible that this record is due to incorrect identifications of *Kinosternon* in Sinaloa (personal observations, HACB) or errors in the assignment of geographical coordinates, as most specimens collected in northwest Mexico were shipped in batches to collections abroad from Mazatlán. Due to these discrepancies and the lack of additional specimens collected in the region, it is suggested to exclude this species from the herpetofauna of Sinaloa. However, the possibility that it may be present in the Sierra Madre Occidental adjacent to Sinaloa cannot be ruled out, hence further verification of its presence in the state is needed.

Recommendations

To enhance the accuracy and integrity of herpetological records in Sinaloa, several recommendations are crucial. Firstly, conducting a thorough review of historical and contemporary records is essential to ensure accurate species identification and to eliminate synonymies and erroneous entries. Secondly, when new records are made and only photographs are available due to ethical and field collection limitations, it is important to provide specific characteristics that aided in species identification, along with photographs from multiple perspectives of the individual. Thirdly, it is essential to minimize errors to optimize management plans, particularly since Sinaloa hosts some threatened species, which can impact assessments conducted by conservation agencies. Finally, the intention is not simply to provide one more list. Herpetological studies in Sinaloa are increasing after five decades without field studies. Moreover, the conservation status of species in Mexico is currently under evaluation. The primary aim is to clarify taxonomic changes regarding Sinaloa's herpetofauna; however, amphibian and reptile records may be reviewed in the corresponding databases following the publication of this manuscript.

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Appendix 1. Acronyms of Scientific Collections

AMNH: American Museum of Natural History; **CMNAR:** Canadian Museum of Nature Amphibian and Reptile Collection; **CNAR:** Colección Nacional de Anfibios y Reptiles, Universidad Nacional Autónoma de México; **UTA-R:** University of Texas at Arlington Amphibian and Reptile Diversity Research Center.

Appendix 2. Supplemental Material

The lists of amphibian and reptile species for Sinaloa, Mexico, can be downloaded from: <https://doi.org/10.5281/zenodo.13159750>.

Notes on Reproduction of New Jersey Chorus Frogs, *Pseudacris kalmi* (Anura: Hylidae)

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Abstract

I conducted a histological examination of gonadal material from 19 *Pseudacris kalmi* adults consisting of 12 adult males and 7 adult females. The smallest mature male (sperm in lumina of seminiferous tubules) measured 22 mm SVL. The smallest mature female (in spawning condition) measured 20 mm SVL. As previously reported for *P. kalmi*, reproduction occurs in the early part of the year (Dodd, 2023). The presence, in two females of ripening (vitellogenic) follicles and concurrent postovulatory follicles (from a recent spawning) in the same ovary (*sensu* Redshaw, 1972) suggests that some *P. kalmi* may spawn more than once in the same reproductive period.

The New Jersey chorus frog, *Pseudacris kalmi* Harper, 1955, occurs in Delaware, Maryland, New Jersey, Pennsylvania and Virginia (Frost, 2024). Lee (1973) and Ethier et al. (2021) reported breeding occurs February to April. *Pseudacris kalmi* breeds in shallow temporary pools in grassy meadows; it colonizes newly restored wetlands (Dodd, 2023). In this paper, I present data from a histological examination of *P. kalmi* gonadal material from a combined sample from Delaware, Maryland, New Jersey and Virginia.

A sample of 19 *P. kalmi* collected 1943 to 1986 (Appendix) consisting of 12 adult males (mean snout–vent length, SVL = 27.1 mm ± 2.3 SD, range = 22–30 mm) and 7 adult females (mean SVL = 28.3 mm ± 4.7 SD, range = 20–36 mm) was examined from the herpetology collection of the Carnegie Museum of Natural History (CM), Pittsburgh, Pennsylvania, USA. Utilization of museum collections for obtaining reproductive information avoids removing additional animals from the wild.

A small incision was made in the lower part of the abdomen; the left testis was removed from adult males and a piece of the left ovary from adult females. Gonads were embedded in paraffin, sections were cut at 5 µm and stained with Harris hematoxylin followed by eosin counterstain (Presnell and Schreiber, 1997). Histology slides were deposited at CM. An unpaired *t*-test was used to test for differences between male and female SVLs.

There was no significant size difference between SVL of males versus females of *P. kalmi* (*t* = 0.75, *df* = 17, *P* = 0.46). Testes of *P. kalmi* are surrounded by black pigment as previously reported for *P. crucifer* by Rugh (1941) and Oplinger (1966). Otherwise, the testicular morphology of *P. kalmi* is similar to that of other anurans as described in Ogielska and Bartmańska (2009a). Within the seminiferous tubules, spermiogenesis occurs in cysts which are closed until the late spermatid stage is reached; cysts then open and differentiating sperm reach the lumina of the seminiferous tubules (Ogielska and Bartmańska, 2009a). There was typically a tangled mass of spermatozoa in the lumen of each seminiferous tubule. All males were undergoing spermiogenesis. By month, numbers of *P. kalmi* males (*N* = 12) were: February (*N* = 1), March (*N* = 6), April (*N* = 4), May (*N* = 1). The smallest mature male (sperm in lumina of seminiferous tubules) measured 22 mm SVL and was from February (CM 139943).

The ovaries of *P. kalmi* are similar to those of other anurans in being paired organs lying on the ventral sides of the kidneys; in adults the ovaries are filled with diplotene oocytes in various stages of development (Ogielska and Bartmańska, 2009b). Mature oocytes are filled with yolk droplets; the layer of surrounding follicular cells is thinly stretched. Two stages were noted in the ovarian cycle of *P. kalmi* (Table 1): Stage 1 (Spawning Condition) in which mature oocytes predominated; Stage 2 (Vitellogenic) in which follicles were accumulating yolk; postovulatory follicles were concurrently present. The smallest mature *P. kalmi* female (in spawning condition) measured 20 mm SVL and was from July (CM 22505).

Postovulatory follicles (evidence of a recent spawning) (Redshaw, 1972) were noted in two *P. kalmi* females from March (Table 1) (CM 30878G, CM 126081). Postovulatory follicles form when the ruptured follicle collapses after ovulation; the follicular lumen disappears and proliferating granulosa cells are surrounded by a fibrous capsule (Redshaw, 1972). Postovulatory follicles are short-lived in most anuran species and are resorbed after a few weeks (Redshaw, 1972). The presence of ripening (yolking) follicles for a subsequent spawning, with concurrent postovulatory follicles from a recent spawning, in the same ovary (CM 30878G, CM 126081) suggests that some *P. kalmi* may spawn a second time during the same reproductive period. This was also noted in the congeneric species, *Pseudacris streckeri* (Goldberg, 2020), *P. fouquetti* (Goldberg, 2021), *P. feriarum* (Goldberg, 2022), and *P. brachyphona* (Goldberg, 2023).

It is plausible that the two gravid *P. kalmi* females from October (Table 1) would have retained their eggs until spring in keeping with Jørgensen et al. (1979) who reported ovaries are

Table 1. Two monthly stages in the ovarian cycle of seven adult *Pseudacris kalmi* females.

Month	n	Spawning Condition	Vitellogenic
March	3	1	2*
May	1	1	0
July	1	1	0
October	2	2	0

* The two vitellogenic March females had concurrent postovulatory follicles (*sensu* Redshaw, 1972).

Table 2. Months of breeding by locality for *Pseudacris kalmi*.

Location	Breeding Period	Source
Delmarva Peninsula	mid-February into May	White and White, 2007
Maryland	February or March into May?	Ruhe, 2018
New Jersey	February to June	Schwartz and Golden, 2002
No specific locality	February to April	Elliott et al., 2009
Pennsylvania*	March to May	Hulse et al., 2001
Virginia	January to March	Beane et al., 2010

* in Pennsylvania as *Pseudacris triseriata*, which includes *P. kalmi*.

close to breeding size by the time of hibernation in frogs from the temperate zone. It is likely the eggs will be utilized during reproduction the following spring.

Three of seven (43%) of the adult females in my *P. kalmi* sample contained atretic oocytes. Atresia is a widespread process occurring in the ovaries of all vertebrates (Uribe Aranzábal, 2009). It is common in the amphibian ovary (Saidapur, 1978) and is the spontaneous digestion of a diplotene oocyte by its own hypertrophied and phagocytic follicle cells which invade the follicle and eventually degenerate after accumulating dark pigment (Ogielska and Bartmańska, 2009b). See Saidapur and Nadkarni (1973) and Ogielska et al. (2010) for a detailed de-

scription of the stages of follicular atresia in the frog ovary. Atresia may influence the number of ovulated oocytes (Uribe Aranzábal, 2011) and can remove females from the breeding population (Goldberg, 2017; 2019).

In conclusion, my data support previous studies indicating *P. kalmi* reproduces in winter–spring (Dodd [2023] and Table 2).

Acknowledgments

I thank Jennifer Sheridan (CM) for permission to examine *P. kalmi* and Mariana Marques (CM) for facilitating the loan 2023–12.

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Appendix

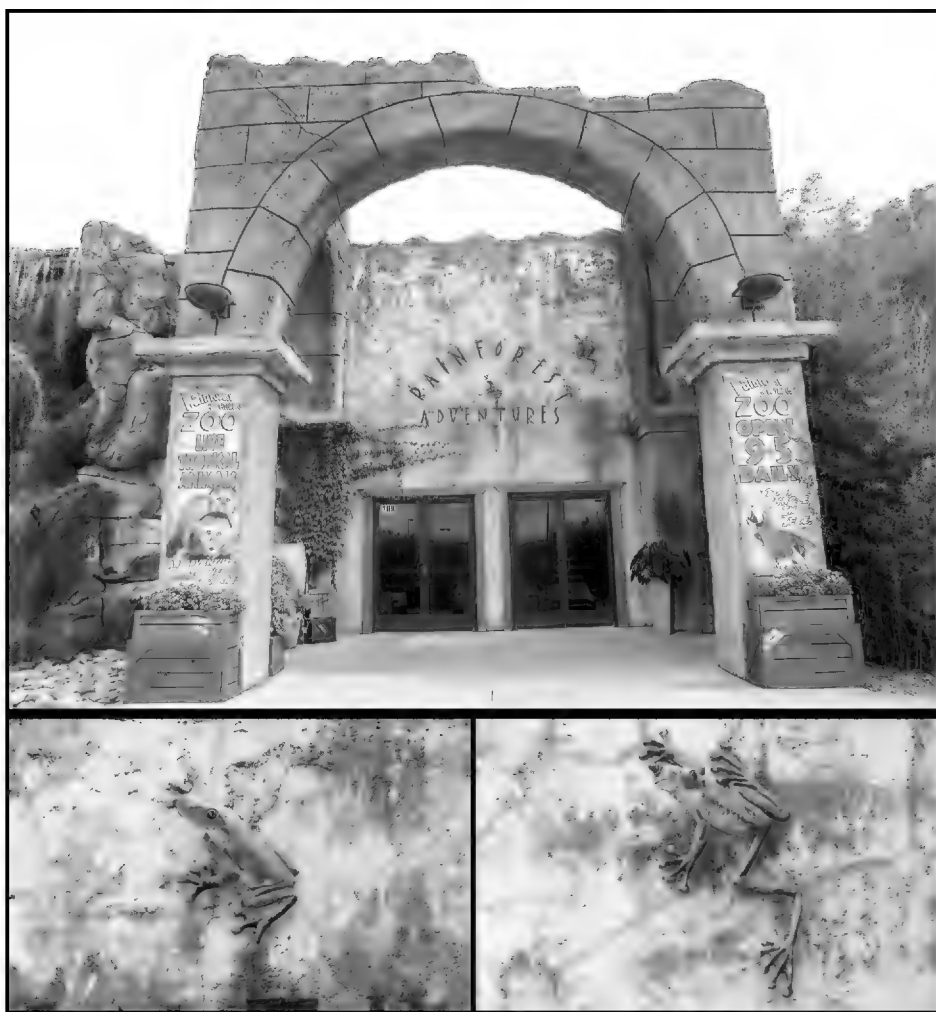
Nineteen *P. kalmi* from examined (by county) from the herpetology collection of the Carnegie Museum of Natural History (CM), Pittsburgh, Pennsylvania, USA. **DELAWARE**: New Castle CM 55825, CM 55832, CM 55833, Sussex CM 55841; **MARYLAND**: Kent CM 139943, Queen Anne's CM 55917H, CM 55922M, Somerset CM 139947, Wicomico CM 22505, CM 27012, CM 27013. **NEW JERSEY**: Alloway CM 55927, CM 55927F, Burlington CM 30878G, Gloucester CM 30877, CM 30878G. **VIRGINIA**: Accomack CM 126080, CM 126081, CM 126086.

Herpetological Art in the RainForest Adventures Zoo — June 19, 2024

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While my wife Holly and I were in the Knoxville, Tennessee, area for the International Herpetological Symposium we visited the RainForest Adventures Zoo in Sevierville, Tennessee. This small zoo has over 600 animals covering 130 species which include reptiles, amphibians, tarantulas, birds, and mammals. There is also a petting zoo with goats and emus. The website is RFAdventures.com.

The front entrance is made to look like an old stone building that has weathered quite a bit. Right above the entrance are two sculptures of red-eyed green treefrogs, *Agalychnis callidryas*, clinging to the wall.



To the left of the entrance up near the edge of the roof is the image of a cobra that is reared up with its hood spread. This was made to look like it's been there a very long time and has weath-

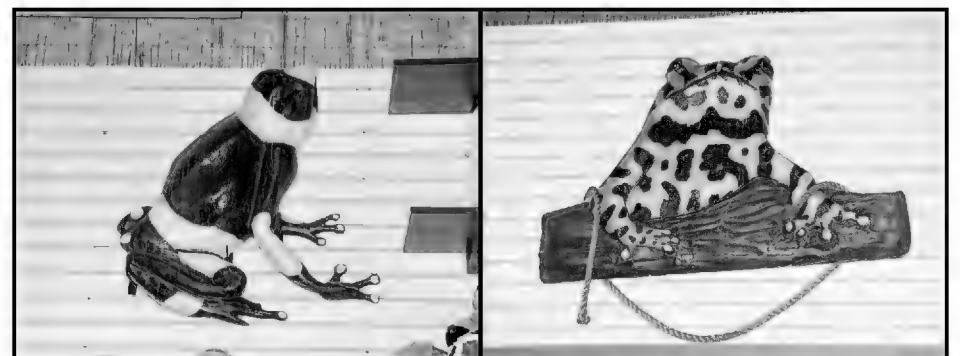


ered quite a lot. It might be about four feet tall.

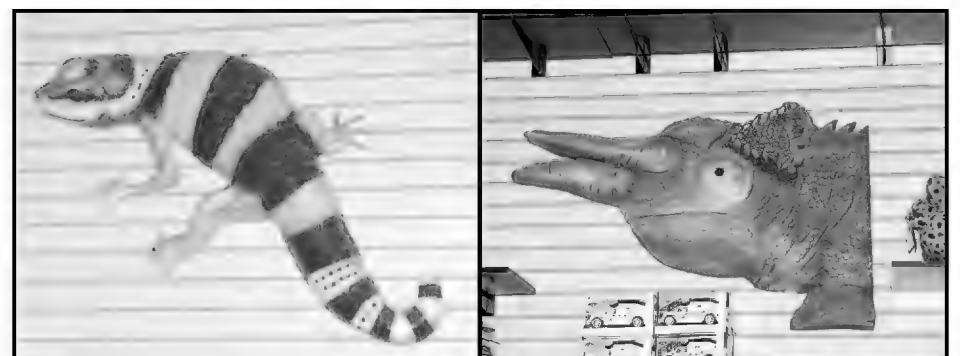
Hanging on the walls of the gift shop are many replicas of reptiles and amphibians. There's a large snake oriented vertically on a board. The snake has brown blotches, a light tan background and is several feet long. There is another snake with similar pattern and coloring that is oriented horizontally on a branch.



There are also several anurans on the walls of the gift shop, including a poison dart frog that is colored black and orange, and one that looks like a firebelly toad that is green with a yellow belly.



In the way of lizards on the gift shop walls there is a banded gecko, *Coleonyx* sp., as well as a replica of the head and neck of a Jackson's chameleon, *Trioceros jacksonii*.



On a table there is a replica of a turtle with a shell that is mostly white and looks like it's almost two feet long and the head, neck and legs are black. There is a sign that reads "Marble Turtle \$1,999.99 Hand carved in Ecuador." I don't normally photograph the mass-produced objects in gift shops, but I wanted to show what may be one-of-a-kind souvenir.



In a hallway there is a display in a covered container that shows two salamanders. If these models are meant to represent salamanders from southeastern Tennessee (where we were), the red one is a northern red salamander, *Pseudotriton ruber ruber*, and the dark one might be a southern Appalachian salamander, *Plethodon teyahalee*. There is a sign that reads "Look, but do not touch! Most of the salamanders in the Park are lungless; they 'breathe' through their skin. Even very gentle handling of these animals can damage and dry out their skin. If that happens the salamander can't breathe!" Both replicas are life-size.



CHS Meetings Are Moving!

Since our founding in 1966, the Chicago Herpetological Society has weathered many changes and overcome many challenges. As a society, we've seen membership wax and wane, held our meetings in several different locations, and have always pulled through because of our members' commitment and dedication to the animals we love and the community we've built together.

One of our most recent challenges was the move of our main meetings to Sunday afternoons, and the subsequent drop in attendance that we've experienced at these monthly meetings. This was never an optimal time, but we did what we had to do—and now a new option has arisen that we feel will better serve our membership. The Elgin Math and Science Academy (EMSA) has graciously offered us meeting space, and the facility is wonderful. Surrounded by a nature preserve, this location will be much easier for many of our members to access, and we're sure that our return to a Wednesday night meeting time will make it possible for more of our members to attend.

While transitions are never easy, we think that the return to Wednesday evenings will be a welcome change, and we hope to see many returning faces! A society is nothing without its members, after all. And for the families who have been enjoying the Junior Herpers meetings on Sundays at the Notebaert—those aren't changing. We'll have two meeting dates and locations instead of just one, giving you more opportunities to engage with what CHS has to offer.

And we know you'll love this part: parking is free and reasonably abundant!

Our EMSA meetings will begin on Wednesday, September 18, at 7:00 P.M. Please make an effort to attend.

EMSA is located at 1600 Dundee Avenue, Elgin IL 60120. Check the *Bulletin* and our social media channels for more information, and don't hesitate to ask any questions you may have about the move and the next steps going forward! The board is here to answer any questions you may have.

UPCOMING MEETINGS

Please try to join us for the next monthly meeting of the Chicago Herpetological Society at 2:00 P.M., Sunday, August 18, at the Notebaert Nature Museum, 2430 N. Cannon Drive, Chicago. **Caitlin Monesmith** will showcase the CHS Junior Herpers program.

The first CHS meeting at our new time and place will begin at 7:00 P.M. on Wednesday, September 18. Please try to join us that evening at the Elgin Math and Science Academy, 1600 Dundee Avenue, Elgin IL 60120. **Myke Clarkson** will provide a virtual presentation on aquatic snakes. Myke is a natural history filmmaker and television producer who currently serves as president of two nonprofits: the International Herpetological Symposium and Herpetological Conservation International. He is the author of several chapters in *Aquatic Snakes: Diversity and Natural History*, edited by John C. Murphy.

Board of Directors Meeting

Are you interested in how the decisions are made that determine how the Chicago Herpetological Society runs? And would you like to have input into those decisions? The next board meeting will be held online. If you wish to take part, please email: rcrowley@chicagoherp.org.

GUIDED TOUR OF THE GROVE

On Saturday, August 31, 1:30 – 3:30 P.M., CHS members can enjoy a guided tour of The Grove nature preserve and National Historic Landmark, 1421 N Milwaukee Avenue, Glenview, IL 60025. With over 150 acres of diverse ecosystems, historic architecture, and a first-class nature center, the Grove has something for everyone. If you'd like to join us, please email Gail (goomens@chicagoherp.org) so we can get an idea of the count.

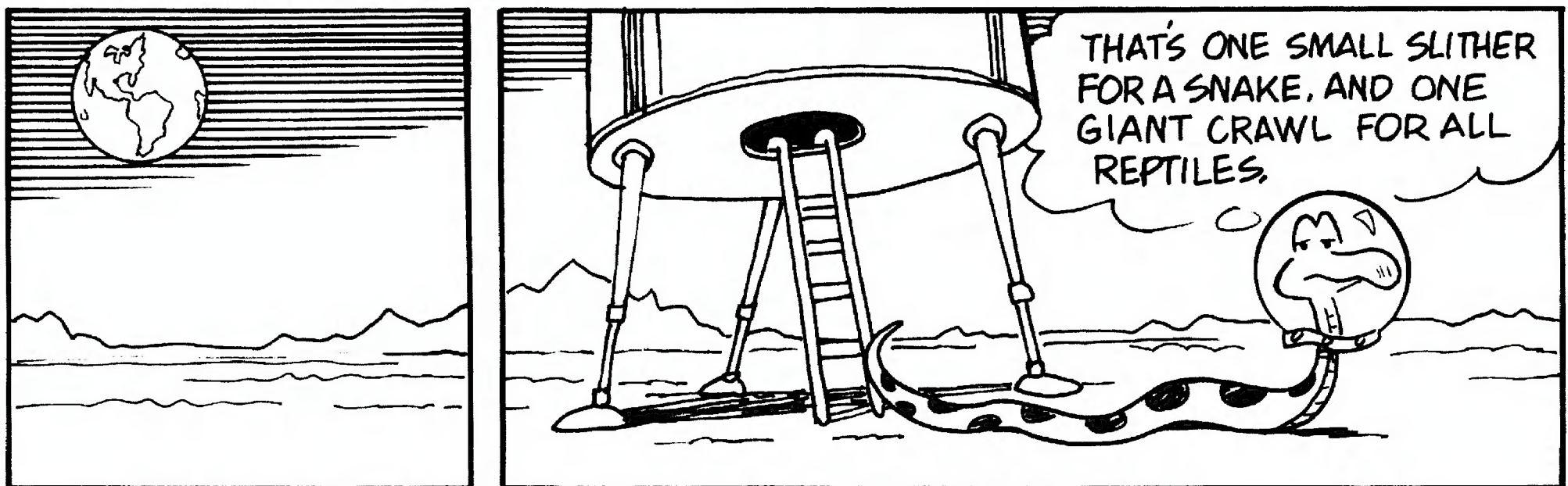
MIDWEST HERPETOLOGICAL SYMPOSIUM

The Midwest Herpetological Symposium is back on track. The St. Louis Herpetological Society will host this year's event September 20–22, at the Hilton St. Louis Airport Hotel. Watch their website and Facebook for more information when it becomes available.

NEW CHS MEMBERS THIS MONTH

Hayden Al Harash
Marsha Lehr

THE ADVENTURES OF SPOT



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